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TORREYA

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Vol. 16 No. 2

BOTANICAL SKETCHES FROM THE ASIATIC TROPICS

BY HENRY ALLAN GLEASON

IV. CEYLON

(Continued from January Torreya)

The shade trees used in the tea gardens at present are almost all Para rubber, *Hevea brasiliensis*, and the planter expects to get two crops from the same land. It is doubtful whether this practice is a good one, for even here the altitude is too high for rubber and scarcely high enough for first-class tea. Other species of shade trees have been used in the past, especially *Eucalyptus* and *Grevillea*, and a few specimens of them are still remaining.

After three weeks at the Botanical Garden, we took the train for Nuwara Eliya, the chief summer resort of the English, located near the southern end of the island at an altitude of 6,200 feet.

There are few railway routes which pass through a more picturesque country than the railway from Peradeniya to Nuwara Eliya. For once one does not regret the slow Ceylon trains. Over similar mountain railways in America, the running time would be two hours or at most three, but here it drags out to six. It is a steady climb of about 100 feet per mile all the way. The builders of the railway seem to have had an aversion to bridges and tunnels, so the line winds back and forth on the sides of the mountains, ascends the valleys to their head on one side and returns on the other, and has more curves and loops than any American railroad.

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Near Peradeniya the tea estates appear only in the background, and the valley land is planted to diminutive fields of rice. In the numerous villages the huts of the natives are surrounded by cacao, coconuts, betel palms, bananas, and bread fruit. As the line ascends progressively higher and higher, these tropical fruits disappear one by one, the banana being about the last to go, at an altitude of 3,800 feet. The little villages gradually disappear also, and the natives all live near the tea factories in barracks called coolie lines. As the villages and tropical vegetation are left behind, the tea gardens expand and eventually monopolize the landscape. It is remarkable what a large amount of space they occupy. One scarcely realizes that the whole world can consume all the tea which they produce, and the scene can be compared only to the almost continuous cornfields of Iowa.

In America one never sees any mountain in cultivation, except a few little clearings here and there, but in Ceylon a whole mountain will be one continuous tea garden from the valley at its base to its very summit. Not an acre of the original jungle is left. Picture a deep valley with the train on one side of it 500 feet or so up. On the opposite side the mountain rises from the valley some 1,500 or 2,000 feet. In either direction, up or down, for a distance of five miles or so the valley is visible, so there is in sight at one time a strip of land ten miles long and probably two or three miles wide. This whole area is almost a solid mass of uniform dark green tea plants, set out in regular rows. Zigzagging over the sides of the mountain are yellow lines where the roads are located. At the bottom of the valley a broader yellow line locates the well-made automobile road. Running vertically up the mountain are rows of light green shade trees about 100 feet apart, standing out sharply against the sky on the very crest and disappearing over the other side. At four or five places in the landscape are the tea factories, huge three-story buildings, black with white trimmings. Somewhere out in the tea fields there are a hundred black specks where the Tamil coolies are picking tea. Now stretch this panorama out over fifty miles of country and it may give some imperfect idea of the Ceylon tea industry.

Here and there the train passes a village where a few English and a crowd of coolies meet it. Occasionally small rock gorges with white waterfalls in them open out into the valley; rarely there is a small patch of forest in a gorge or along an especially rocky place; but in every direction there is tea and yet more tea as far as the eye can reach.

Tea will flourish at great altitudes in this country. Several years ago the government decided to sell no land above the 5,000-foot level. This is intended not merely to preserve the forest and to make permanent the supply of forest products, but chiefly to control the headwaters of the rivers and reduce the dangers of floods. Before this decision was made a good deal of land at the higher elevation had already been sold and is now planted to tea. Nevertheless, the tops of most of the higher mountains are still forested, and one can easily see how some of the estates run right up to the limit, leaving a horizontal forest margin around the whole mountain. This is the only reason for the absence of tea, however, and it is quite likely that the whole mountain region of Ceylon would be one vast tea garden but for this governmental regulation.

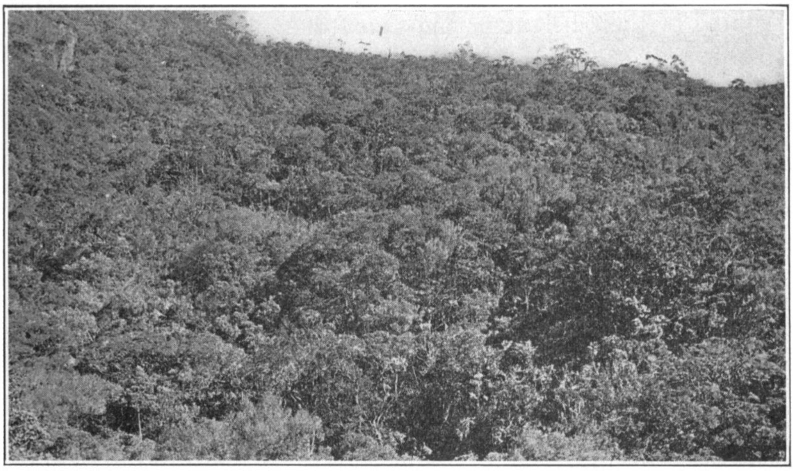

FIG. 33. The mossy forest of Ceylon, altitude 6000 feet.

The shade trees in the lower levels are mostly Para rubber.

As one goes higher the cooler climate prevents the growth of rubber and it is replaced by acacia, Australian oak, and eucalyptus. In still higher altitudes shade trees are not necessary.

We left the mountain line of the railway at Nanu-oya and completed our trip to Nuwara Eliya by a seven-mile ride over a narrow-gauge railway. In this distance it climbs an even thousand feet and is even more crooked than the main line. At this altitude, well above the governmental limit, much of the original forest is left and from the train window one gets an excellent view across the valleys of its superficial appearance.

From this bird's-eye view, the mossy or subalpine forest presents a most picturesque and characteristic appearance. Across the valley one sees only the tops of the trees and notes nothing of their height or the shape of their trunks. It is the color which is strange. Of course, the color is green, speaking generally, but there is every shade from the palest yellow green to the darkest olive. Mingled with these are all sorts of russets, browns, crimsons, yellows, and neutral tints, but all soft in tone and harmonious. These colors are partly natural to the full grown leaves, but they generally indicate trees on which the young leaves are just unfolding or the old leaves are dying. I did not believe before reaching Ceylon that tropical trees may turn as bright in color as those of temperate zones when the leaves get ready to fall, but several species of these mossy forests are as brilliant as our American oaks and maples. The general effect of this color combination makes the forest a very pleasant mosaic, not at all monotonous like the summer green of an American forest. When seen at a greater distance on the sides of distant mountains the separate colors tend to lose their identity and blend to form an exceedingly rich soft velvety green.

The little town of Nuwara Eliya contains a large number of good hotels and its sole function seems to be to provide a cool climate for the English during the hot season in the lowlands. At night the thermometer drops into the forties and on one occasion during our stay there was a heavy white frost. During the day the sun is exceedingly bright but the temperature does not exceed 75. With a bracing climate, comfortable hotels, and virgin vegetation on every side, it is a most attractive place for a botanist to visit, and the mountain garden at Hakgala is only six miles away.

Mountains rise on all sides of the flat valley in which Nuwara Eliya is situated. Most of these reach an altitude of 7,000 feet or more, and at the north side of the town stands Pidurutalagala, commonly called Pedro by the English, about 8,300 feet high and the highest mountain in Ceylon. This is an old settlement and some tea estates were planted before the altitude restriction went into effect, so that the sides of some of these mountains are now planted with tea. Most of them, however, are still covered with the virgin mossy forest.

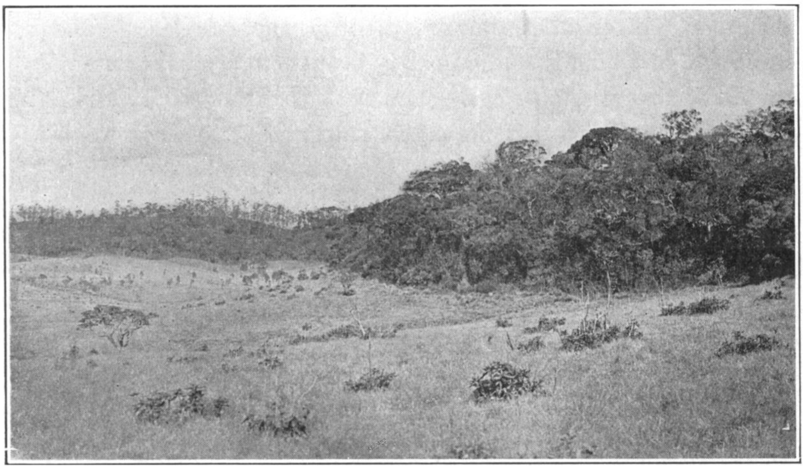

FIG. 34. Young *Rhododendron arboreum* in the patana. A mature tree appears at the left. Ceylon.

Entering the mossy forest on the sides of Pedro, one finds that the interior is very different from its charming exterior. The trees are low, not over 30 feet high, and crooked with gnarly branches. The leaves are small, stiff and leathery, and mostly clustered at the ends of the branches. Trunks and branches alike are overgrown with mosses. The undergrowth is remarkably dense and in some places the forest is well-nigh impenetrable. We were able to recognize but few of the herbaceous species, but it was easy to see that many of them are of temperate-zone affinity. They are violets and brambles, various species of composites and valerians, and several species of melastomes. There are tall specimens of *Solanum indicum* with blue flowers and very prickly stems, a *Vernonia*, a few gingers with clusters of red flowers, and a matted, tangled, impenetrable bamboo with hispid, almost nettle-like, leaf sheaths.

The most remarkable feature of the forest, however, is the frequent dense growth of *Strobilanthus*. This is a short-lived shrub of the *Acanthus* family. It has opposite leaves and a square stem which is seldom freely branched, so that it assumes the habit of a giant *Coleus*. The bark is rather thick, but soft and juicy, and grayish brown in color. The stem is slightly enlarged at each node and may be three or four inches in diameter. These plants do not occur everywhere through the mossy forest, but only in dense patches, where the stems are almost as close as wheat. Being short-lived the ground is carpeted with fallen stems and since these are woody they do not decay at once but may accumulate to a depth of two or three feet. Walking through a patch of *Strobilanthus* is an exceedingly arduous task, as one can easily imagine.

Trimen in his Flora of Ceylon has an interesting paragraph on the habits of *Strobilanthus:* "Many of the species which grow in the upper montane zone are remarkable for their gregarious occurrence in vast abundance and over large areas. The principal ones, especially common, and together or separately forming unbroken sheets of undergrowth in the forests, are *S. viscosus*, *asperrimus*, *calycinus*, and *sexennis*. . . . These live for several years without flowering, growing close together with straight erect stems, which in some reach a height of 8–10 ft., are quite woody, and several inches in diameter. A few flowers may here and there be found every year, but it is not until the plants reach a certain age, apparently usually from 10–13 years, that the whole patch or area bursts into simultaneous blossoming. These patches or districts are often of great extent, and the boundaries between those of different ages are very conspicuous, being as distinct as if artificially sown. After this general and profuse flowering the whole patch begins to wither and ripen to seed—a process which takes several months or even a year (whence ripe seed is rarely found in herbariums), and then dies down. There is probably a patch to be found flowering somewhere in the mountains every year. The wood is hard but brittle, with a large pith and makes very good fuel, and the flowers are often beautiful."

The height given by Trimen is sometimes exceeded. We estimated the average height of one patch at twelve feet, and measured one plant of sixteen feet.

All this underbrush makes a very dense interior and once within the forest all view of it is shut off completely. In the deepest and shadiest ravines there are small tree ferns ten feet high or less.

In the original forest the smaller plants must be confined chiefly to shaded rock outcrops and to the immediate vicinity of streams. They are found most easily along the paths cut through the forests. These are nearly always on the hillsides and consequently have a vertical face as well as a little strip of flat ground. Here the ground is covered with numerous small species, including *Viola serpens*, with a flower like our *V. striata;* a melastome, *Osbeckia* sp., with a flower like a wild rose; a smaller melastome, *Sonerila zeylanica;* some leafy liverworts and mosses, and various small ferns of various form and genera.

The flat valley in which Nuwara Eliya is located is largely treeless and occupied by gently rolling meadows which appear as if artificially cleared. These meadows are a part of the peculiar formation known in Ceylon as patanas. The first of these are found near Nuwara Eliya and towards the south and east from that place they occupy ever increasing proportions of the land. At this altitude they are mostly in virgin condition and offer interesting opportunities to the plant ecologist.

The first patana which we visited is called Moon Plains, lying some four miles east of Nuwara Eliya. Ascending a winding path through a tea estate, one catches occasional glimpses of the open plain ahead, and finally comes out at one end of the patana, some hundred feet above it, and with its whole area in full view before him. Moon Plains is approximately a mile long from east to west and half a mile wide. It lies at an altitude of about 6,500 feet, but is itself of comparatively low relief. From the edge of the patanas on the hills to the rather broad valleys is probably always less than 200 feet, and usually less than 100. However, from the highest end of the patana to the bottom of the canyon which drains it at the other end may be as much as 300 feet. The slopes of the hills lie at a low angle also, so that the whole patana has a gently undulating surface. From one end to the other, hundreds of *Rhododendron* trees, *Rhododendron arboreum*, are scattered over it, but always at considerable intervals, so that they can in no case be dignified collectively by the term grove, forest, or thicket.

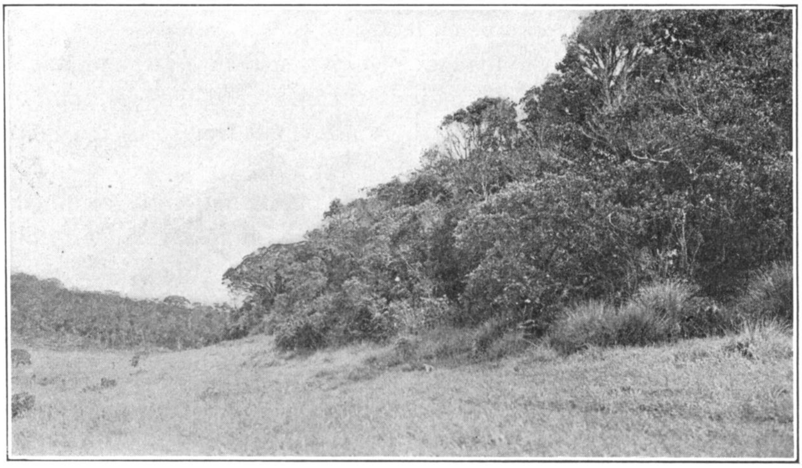

FIG. 35. The sharp transition zone between the patana and the mossy forest. Ceylon.

Even from a distance one can distinguish by their color the three component associations. One of these, which may be called for convenience the dry grassland, occupies probably 90 per cent of the area.

The dry grassland association occupies all the hilltops and hillsides from the edge of the forest down nearly to the bottom of the valleys. Throughout, the soil is loose, coarse, and gravelly, and drainage must be rapid and thorough. The lower margin of the association shows an obvious correlation in space with the drainage system, and is probably determined physiologically by the water relation of the plants.

The ground cover is a close, heavy, matted sod, four to six inches thick, composed apparently of five dominant species of grasses, and, near the end of the dry season in March, a dull grayish green in color. One species only still retained the old culms and inflorescences, but the latter were so badly shattered that we were unable to recognize even the tribe to which it belonged. All the species have matted narrow leaves, and some of them are decidedly pubescent, indicating the xerophytic conditions under which they live during the dry season.

The secondary species are (in March, at least) exceedingly few in number and show little indication of any vegetative activity. Their usual height is about a foot. The commonest species, *Anaphalis brevifolia*, has a few spreading branches and is closely gray-pubescent. The association is speckled with them in every direction, and reminds one of the appearance of similar gray plants in the short-grass association of the American prairies.

Most of the secondary species were completely unrecognizable at the time of our visit. The few that could be identified included the melastome *Osbeckia Walkeri*, *Vernonia Wightiana*, the rubiad *Heydotis verticillaris*, simulating in habit a diminutive yucca, and *Pteris aquilina*. In general, the composites and melastomes seemed to be most abundantly represented. At the lower margin of the association, an occasional plant of the prostrate creeping *Lycopodium carolinianum* appeared, and a few other plants belonging properly to the next association.

At the bottom of the valleys lies the second association, which may be termed conveniently the wet grassland. It is narrow or wide, depending on the contour of the valley; sometimes interrupted, where the drainage has eroded a vertical-sided gorge, sometimes extending in a narrow line up the hills almost to the forest margin, or spreading out below over areas a hundred feet or more wide. Here, again, the dominant species are grasses, but they grow now in large bunches, forming a loose tangle one to two feet thick. Also, even in the dry season, they retain their green color. Secondary species are no commoner and no more conspicuous than in the dry grassland, but they are greener and in every way more mesophytic. *Lycopodium carolinianum* is especially common, and *Ranunculus sagittifolius* is frequent.

The third association is very limited in size, and occurs only on muddy spots on the hillsides where subterranean drainage comes to the surface. The dominant grass here is *Arundinaria densifolia*, two to three feet high, with erect crowded leaves. On the mud beneath it are mats of *Lycopodium carolinianum*, a blue-flowered bladderwort, *Utricularia coerulea*, a sundew, *Drosera Burmanni*, *Juncus prismatocarpus*, *Eriocaulon*, and various other species.

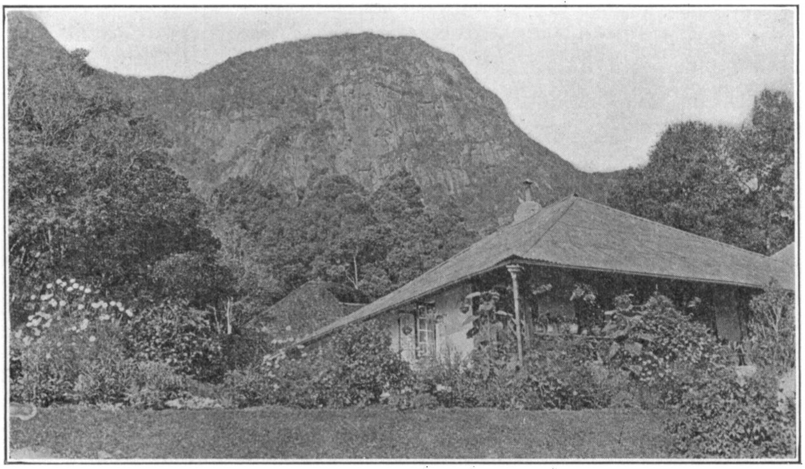

FIG. 36. A residence in the mountain garden; Hakgala Peak rises abruptly at the rear of the garden.

The *Rhododendron* trees demand close attention. They may be found in a number of stages, from little ones a foot or so high up to mature trees of twenty feet. The young trees are not safe from fires until they reach a height of five or six feet. Below that size the stems are easily killed, and numerous sprouts appear from the base, and grow up to meet the same fate a year or two later. Such clumps of sprouts are very common, especially in the wet grassland association. If the tree is spared until it has passed the critical size, it apparently grows to maturity in spite of later fires. Almost every one of the older trees shows the scars of fire, invariably on the southwest side of the trunk, and seldom extending over four feet from the ground. The older trees are doubtless protected from fire by their thick heavy bark. In some cases, repeated fires have destroyed one side of the tree completely, leaving only a U-shaped zone of living tissue.

The branches of the *Rhododendron* are stiff, gnarled, and crooked, and the thick leathery elliptical leaves are grouped in rosette-like clusters at the tip of the twigs. The tree has a peculiarly fantastic appearance which can not be paralleled in temperate North America, unless possibly in the chaparral of the extreme southwest. The habit is however by no means uncommon among the trees of the mossy forests which surround the patanas.

The forest margin is everywhere abrupt, but especially so on the northeastern side of the patanas. Here there is usually a marginal zone of a tall *Andropogon*-like grass (possibly *A. nardus*), five feet wide, then a narrow zone of *Rubus* and melastomaceous shrubs, three feet wide, and beyond that the vertical, opaque, apparently impenetrable forest wall. As Willis wrote, in two strides one can pass from forest to patana, or the reverse.

The opposite margin of the patana is not so abrupt. The *Rhododendron* trees become more numerous nearer the forest, the zone of shrubbery broadens out and includes many more species, and the forest itself slopes back, in profile view, from small trees in front to larger ones behind.

Various theories have been advanced to explain the origin of the patanas. Whatever their origin may have been, their perpetuation is certainly due to the annual fires which sweep across them. March is the dryest month at Nuwara Eliya, and shortly after the opening of the southwest monsoon, in April or May, the patanas are fired. The old grasses are burned off, many of the young trees killed, and, as a result of repeated burnings, the forest itself is slowly invaded, especially at the northeast side, the direction toward which the fire advances. In the opposite direction, toward the southwest, the fire moves more slowly, and probably seldom attacks the forest margin. On this side, therefore, the zone of marginal shrubbery is much wider.

There are a few places near Nuwara Eliya where tea estates and patanas are adjacent. Here the fires have been carefully prevented in order to avoid damage to the tea. In such places the patanas have been rapidly overgrown with *Rhododendron* and other trees and shrubs, and various other species of the mossy forest are colonizing among them. Apparently only a few years are necessary for the complete reëstablishment of the mossy forest.

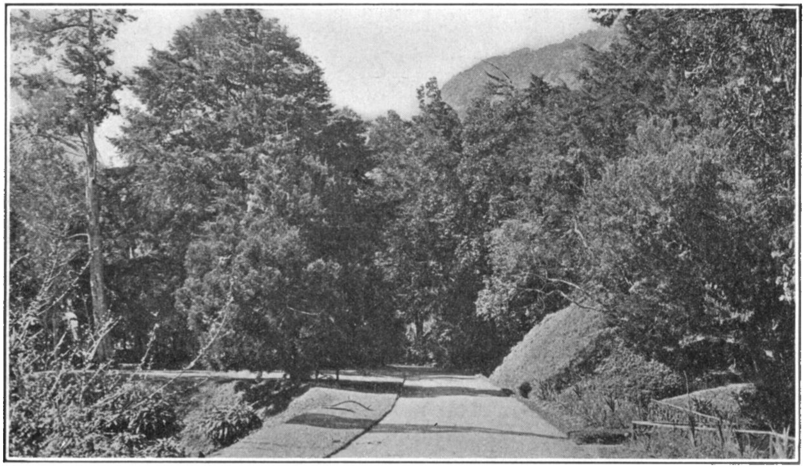

FIG. 37. A drive through the mountain garden at Hakgala, Ceylon.

The shrubs of the broader forest margins and of the earlier stages in reforestation are very interesting. Most conspicuous among them is *Hypericum mysorense*, eight to ten feet tall, with numerous showy yellow flowers. It looks exceedingly bizarre to see its branches occupied, as they frequently are, by the mistletoes *Loranthus sclerophyllus* and *L. suborbicularis*, or sometimes by a small orchid. Melastomes of several species are abundant, including *Osbeckia rubicunda* and *Rhodomyrtus tomentosus*. Other common species are *Pavetta involucrata*, of the Rubiaceae, and *Rauwolfia densiflora*, of the Apocynaceae.

In these thickets are several species of temperate zone affinities, including *Berberis aristata*, *Rubus lasiocarpus*, *R. moluccanus*, *Lysimachia ramosa*, *Valeriana Moonii*, *Campanula fulgens*, *Sanicula europaea*, *Gaultheria fragrantissima*, *Rubia cordifolia*, and *Cynoglossum micranthum*. *Ulex europaeus* is naturalized freely in the patanas immediately about the town of Nuwara Eliya, and seems to flourish. *Verbascum Thapsus* is also a common roadside weed, but appears less hairy than in America.

The most noteworthy roadside plant of the region is a lobelia, *L. nicotianaefolia*. It has the general habit of the mullein, and grows in the same habitat, but its suffrutescent stems reach a height of twelve feet.

Six miles from Nuwara Eliya along a beautiful macadamized road lies the mountain garden of Hakgala. It is located at an altitude of about 5,000 feet, at the foot of the precipitous Hakgala Peak. The garden grounds are very attractive, and present a very interesting display of conifers and tree ferns.

(*The end*)

PARTHENIUM LLOYDII, A NEW MEXICAN GUAYULE

By Harley Harris Bartlett

In the summer of 1909 Prof. F. E. Lloyd referred to the writer for study and description a *Parthenium* which he believed should be segregated from *Parthenium argentatum*, the rubber-plant of Chihuahua and neighboring states. Since that time Prof. Lloyd has pointed out and illustrated the distinctive characters of the two plants,* so that it is only necessary to present an abstract of his account and a formal diagnosis of the new species.

In *Parthenium argentatum* the monopodial growth of the seedling is terminated by the development of the first inflorescence. Extension of the stem system takes place at the base of the well-differentiated peduncle, by the growth at that point of two or three branches, whose growth is in turn terminated by inflorescences. As a result of this sharp delimitation of leafy stem and

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* See p. 55 of his monograph entitled Guayule, a Rubber-Plant of the Chihuahuan Desert. Carnegie Institution of Washington, Publication No. 139, 1911.